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United States
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Agriculture

Forest Service

**Intermountain
Research Station**

Research Paper
INT-408

July 1989

Responses of Birds and Small Mammals to Single-Tree Selection Logging in Idaho

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ACKNOWLEDGMENTS

Authors acknowledge James R. Groves, Robert Jordan, Stanley K. Baker, Shiela Donovan, Daniel A. Dolezal, Walter F. Megahan, James L. Clayton, Timothy L. Mosko, Delbert C. Molitor, Kathleen Geier-Hayes, and Russell A. Ryker for their contributions to this research. Gwladys E. Deiss designed the cover illustration.

RESEARCH SUMMARY

Responses of birds and small mammals to logging depend on the cutting methods used and the degree to which forest stands are altered. This study examined short-term changes in the composition and abundance of small mammals and breeding birds following single-tree selection logging in an Idaho Douglas-fir forest. Populations of birds and small mammals were estimated on a logged plot and on a nearby unlogged plot from 1975 (2 years prelogging) to 1979 (3 years postlogging).

Total numbers of breeding birds were relatively stable between years and between logged and unlogged plots. More pronounced patterns of response occurred in the populations making up the breeding bird communities. Species with positive numerical responses to the selection cut were olive-sided flycatcher, Swainson's thrush, yellow-rumped warbler, and chipping sparrow. Species with negative numerical responses to logging were red-breasted nuthatch and brown creeper. Fourteen other species showed little numerical response to the timber harvest.

Birds that forage by gleaning the surface of the bark (timber gleaners) declined in number after logging. Foliage feeders, aerial-sally feeders, and timber drillers were about equally abundant before and after logging. The ground gleaning guild showed a slightly positive pattern of response. Of six nesting guilds represented, only the secondary cavity nesters were adversely affected by logging. Bush and small tree nesters tended to increase after timber harvest.

Deer mice, yellow pine chipmunks, and boreal redback voles accounted for 93 percent of 815 individual animals trapped during the study. Postlogging estimates of deer mice density were generally similar on both the logged and the unlogged plots. But when results were expressed as the mean number of individual animals trapped each year, significantly fewer deer mice were trapped on the logged plot. Numbers of yellow pine chipmunks increased on logged sites; it was the most commonly trapped small mammal in postlogging environments. No significant difference was found in the number of redbacked voles trapped in the cut and uncut forest. Other species were trapped irregularly and in smaller numbers.

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INTRODUCTION

Alterations in the structure of forest vegetation caused by logging produce changes in the organization of associated bird and small mammal communities. Population responses to logging depend on the cutting methods used and the degree to which stands are altered. The effects of clearcut logging have been extensively reviewed (Blake 1982; Halvorson 1982; Martell 1983; Medin 1985; Scott and others 1982; Szaro and Balda 1979). Populations of some birds and small mammals may increase while others decline in postclearcut environments (Medin 1985, 1986).

Few studies have been conducted on the effects of other methods of tree removal (but see Campbell and Clark 1980; Franzreb and Ohmart 1978; Scott and Gottfried 1983). Alternative cutting methods include the selection method where the oldest or largest trees in a stand are removed either singly (single-tree selection) or in groups (group selection) without completely clearing the entire stand (Smith 1962).

This study, conducted from 1975 to 1979, examined short-term changes in the composition and abundance of small mammals and breeding birds following single-tree selection logging in a Douglas-fir (*Pseudotsuga menziesii)* forest in west-central Idaho. Data were collected as part of a study of the environmental effects of logging and associated road construction in the Idaho batholith, a large region (16,000 mi^2) characterized by steep topography and shallow, erodible soils (Megahan 1983). Selection cutting is one of several timber harvesting methods currently being evaluated for their multiple effects on the forest ecosystem.

Common and scientific names of birds and small mammals referred to in this paper are listed in appendix I.

STUDY AREA

The study was conducted on two experimental watersheds of 319 acres (SC-3) and 67 acres (SC-7) in the Silver Creek drainage, a tributary of the Middle Fork of the Payette River in Valley County, ID. These third-order watersheds range in elevation from 4,600 to 6,500 ft and are representative of forested drainages found in midelevation, nonglaciated landscapes of the Idaho batholith. Slopes are steep and dissected. Watershed SC-3 drains to the southeast; watershed SC-7 drains to the northwest. The area has a Mediterranean climate with hot, dry summers and cool, moist winters. Annual precipitation averages 39 inches, with about 65 percent falling as snow (Megahan and others 1983). High-intensity convective rainstorms are common during the summer months.

Douglas-fir and ponderosa pine (*Pinus ponderosa*) are the dominant overstory trees, with scattered stands of grand fir (*Abies grandis*), lodgepole pine (*Pinus contorta*), and Engelmann spruce (*Picea engelmannii*). Mallow ninebark (*Physocarpus malvaceous*), and white spiraea (*Spiraea betulifolia*) normally dominate the shrubby undergrowth. Rocky Mountain maple (*Acer glabrum*), snowberry (*Symphoricarpos* spp.), common chokecherry (*Prunus virginiana*), blue huckleberry (*Vaccinium globulare*), and western serviceberry (*Amelanchier alnifolia*) are often present. Willows (*Salix* spp.) and alders (*Alnus* spp.) are locally abundant, especially on the north-facing watershed. Many forbs and graminoids occupy the ground layer.

Two main habitat types (Steele and others 1981) occur: Douglas-fir/ninebark, ponderosa pine phase, and Douglas-fir/white spiraea, ponderosa pine phase. The experimental watersheds also include elements of the grand fir/blue huckleberry and subalpine fir (*Abies lasiocarpa*)/blue huckleberry habitat types (Ryker 1973).

LOGGING PROCEDURE

Selected trees in watershed SC-7 were marked and felled within a defined cutting unit boundary. Watershed SC-3 served as a nearby unlogged control. The logged cutting unit was irregularly elongate and followed the topographic boundary of the experimental watershed. Uncut buffer zones bordered stream channels and averaged 50 ft to first-order or second-order stream channels, and 100 ft to the third-order (main) stream channel. Logs were yarded by helicopter to minimize site damage, a common practice on steep slopes in the Idaho batholith. Logging slash was lopped and scattered.

A prelogging timber volume on the cutting unit of 17,087 bd ft per acre was reduced 29 percent by the selection-cut logging. There were 47 trees (>9 inches diameter at breast height) per acre on the watershed before cutting; 38 trees per acre remained after logging (McKenzie 1987). The cutting was originally targeted to reduce prelogging stand volume on the experimental watershed by 30 to 35 percent. Logging began in September and was completed in October 1976.

STUDY METHODS

Bird and small mammal study plots were established on each of the experimental watersheds before logging. Bird and small mammal populations were estimated annually beginning in 1975 (2 years prelogging) and ending in 1979 (3 years postlogging). Trees were harvested on the logged watershed after completion of field work in the autumn of 1976.

Breeding Birds

Two plots of 20 acres each were censused for breeding birds using the Williams spot-map method (International Bird Census Committee 1970). Methodological difficulties and other special problems of the mapping method are summarized by Oelke (1981). Plots were rectangular and varied slightly in shape depending on topography and cutting unit boundaries. Plots were surveyed and gridded in a Cartesian coordinate system with points flagged and numbered with stakes at 164-ft intervals. At least 10 census visits were made annually to each plot from mid-May to late July. Most of the bird registrations were recorded from sunrise to late morning when birds were most active. To ensure complete coverage, the plot was censused by walking within 82 ft of all points on the grid. Observations and registrations extended well beyond plot boundaries. Census routes were varied.

At the end of the sampling period, concentrated groups of registrations and coded activity patterns were circled as indicating areas of activity or approximate territories. Fractional parts of boundary territories were estimated to the nearest one-quarter territory. Results were converted to the number of pairs of breeding birds per 100 acres. Estimates of bird species diversity followed Hill (1973).

Small Mammals

Small mammal populations were estimated on two permanently marked 5.6-acre trapping grids. Grids were located near the center of the larger bird census grids. Each grid measured 495 by 495 ft and consisted of 100 trap positions regularly spaced at 55-ft intervals in 10 rows and 10 columns. One metal Tomahawk live trap, 3 by 3 by 10 inches, was placed near each position. Traps were baited with a mixture of cracked corn, wheat, and rolled oats. Surgical cotton was placed in each trap to minimize death from exposure. Captured animals were ear-tagged with Monel fingerling tags and released at the point of capture. Trapping was conducted annually for a 6-night period on each grid in August and early September.

Populations of the deer mouse, yellow pine chipmunk, and boreal redback vole were estimated by means of the mark-recapture method and the Schnabel estimator (as described in Overton and Davis 1969). The effective trapping area was considered to be the dimensions of the grid plus a strip whose width was equal to half the average range length added to each side. Range length was determined by the "adjusted range length" method described by Stickel (1954).

As an additional indicator of abundance, the number of individual animals caught in each 6-night trapping period was used for deer mice, yellow pine chipmunks, redback voles, shrews, western jumping mice, and the sum of other small mammals that were trapped in small numbers.

Data Analysis

The analysis of breeding bird populations was performed on the differences between corresponding means for the two study plots (that is, the mean of the logged plot minus the mean of the unlogged plot). We felt that the mean level of such differences should have neither an upward nor downward slope during the period prior to logging. Once logging had occurred, an upward slope would indicate that logging had increased the breeding bird density while a downward slope would indicate a decrease. With this in mind, a grafted-polynomial model was fitted to the data. The model assumed a slope of zero for the prelogging period (1975 to 1976) and allows either a negative or positive slope for the three postlogging years (1977 to 1979). The probabilities presented in table 1 test the hypothesis of a change in slope beginning after logging. A small probability, say $P<0.05$, suggests a change in slope.

A contingency table analysis was performed on the number of individual small mammals trapped on logged and unlogged study plots. The chi-square test was designed to detect differences in the pattern of numbers of mammals trapped between the logged and unlogged plots. Although the analysis was based on individual counts rather than means of counts, the means are presented in table 2 to make it easier to see the patterns. The confidence limits presented in figure 1 use calculations for estimates of small mammal population densities given by Overton and Davis (1969).

Because this study was not replicated, it was necessary to make the assumption of independence among yearly observations in order to perform the analyses. Even with this assumption, the tests are not powerful. Therefore, we may have failed to detect some changes that took place (large Type II error), but it is unlikely that the differences we discuss are by chance alone (small Type I error). The assumption of independence from year to year, although not strictly true, is probably inconsequential in view of the rather dramatic postlogging changes in some of the bird and small mammal populations.

Table 1—Density (pairs per 100 acres), diversity, and other attributes of breeding birds on logged and unlogged study plots, west-central Idaho, 1975 to 1979

Species	Feeding guild[1]	Nesting guild[2]	Density										
			Unlogged					Prelogging		Postlogging[3]			
			1975	1976	1977	1978	1979	1975	1976	1977	1978	1979	Probability[4]
Calliope hummingbird	FNI	BTN	3.7	7.5	5.0	7.5	7.5	3.7	6.2	5.0	7.5	8.7	0.099
Hairy woodpecker	TDI	PCN	2.5	2.5	5.0	2.5	5.0	1.2	5.0	2.5	2.5	2.5	.707
Northern flicker	GGI	PCN	3.7	2.5	2.5	2.5	2.5	1.2	2.5	2.5	1.2	2.5	.582
Olive-sided flycatcher	ASI	CTN	0	0	0	0	+[5]	0	+	+	3.7	3.7	.032
Empidonax flycatcher[6]	ASI	BTN	13.7	20.0	20.0	17.5	16.2	31.2	25.0	23.7	27.5	27.5	.973
Mountain chickadee	FGI	SCN	13.7	17.5	18.7	15.0	10.0	12.5	15.0	15.0	12.5	8.7	.528
Red-breasted nuthatch	TGO	SCN	21.2	17.5	15.0	17.5	23.7	20.0	17.5	12.5	8.7	12.5	.004
Brown creeper	TGO	SCN	+	+	6.2	10.0	13.7	8.7	6.2	5.0	7.5	10.0	.035
Winter wren	GGI	GRN	0	0	+	+	0	5.0	0	5.0	8.7	2.5	.668
Golden-crowned kinglet	FGI	CTN	+	3.7	+	2.5	0	5.0	3.7	5.0	3.7	5.0	.707
Ruby-crowned kinglet	FGI	CTN	0	+	0	0	2.5	+	5.0	2.5	2.5	2.5	.490
Townsend's solitaire	FFO	GRN	0	1.2	+	+	0	5.0	3.7	1.2	+	+	.071
Swainson's thrush	FFO	CDN	37.5	25.0	21.2	33.7	26.2	42.5	31.2	33.7	43.7	45.0	.038
Hermit thrush	FFO	BTN	2.5	0	3.7	+	2.5	0	+	+	0	+	.889
American robin	GGI	BTN	7.5	6.2	5.0	5.0	7.5	7.5	2.5	5.0	8.7	5.0	.753
Varied thrush	GGI	BTN	0	+	+	0	0	+	+	2.5	+	0	.891
Solitary vireo	FGI	CDN	5.0	1.2	7.5	7.5	2.5	3.7	7.5	13.7	10.0	10.0	.461
Warbling vireo	FGI	BTN	0	0	0	0	0	0	0	+	+	3.7	.126
Nashville warbler	FGI	GRN	+	3.7	2.5	5.0	3.7	5.0	12.5	16.2	10.0	8.7	.606
Yellow-rumped warbler	FGI	CTN	13.7	13.7	12.5	5.0	2.5	13.7	20.0	18.7	15.0	15.0	.049
Townsend's warbler	FGI	CTN	+	10.0	7.5	+	+	7.5	8.7	11.2	17.5	12.5	.153
MacGillivray's warbler	FGI	BTN	12.5	12.5	13.7	22.5	23.7	13.7	17.5	18.7	21.2	33.7	.528
Western tanager	FGI	CTN	22.5	22.5	17.5	20.0	18.7	20.0	20.0	16.2	16.2	12.5	.092
Black-headed grosbeak	FGI	CDN	0	0	+	0	+	0	2.5	3.7	+	+	.493
Chipping sparrow	GGG	BTN	15.0	22.5	18.7	10.0	10.0	13.7	20.0	18.7	18.7	25.0	.005
Dark-eyed junco	GGG	GRN	20.0	17.5	22.5	16.2	17.5	15.0	17.5	21.2	25.0	17.5	.388
Cassin's finch	GGG	CDN	+	5.0	7.5	+	3.7	+	5.0	5.0	5.0	2.5	.800
Pine siskin	FGG	CDN	+	2.5	+	2.5	3.7	5.0	3.7	2.5	5.0	2.5	.199

(con.)

Table 1 (Con.)

Species	Feeding guild[1]	Nesting guild[2]	Density: Unlogged 1975	Unlogged 1976	Unlogged 1977	Unlogged 1978	Unlogged 1979	Prelogging 1975	Prelogging 1976	Postlogging[3] 1977	Postlogging[3] 1978	Postlogging[3] 1979	Probability[4]
Total pairs per 100 acres			194.7	214.7	212.2	202.4	203.3	240.8	258.4	266.9	282.0	279.7	
Total individuals per km²			974	1,074	1,061	1,012	1,016	1,204	1,292	1,334	1,410	1,398	
Standing crop biomass (g per ha)[7]			229	213	216	203	215	234	243	258	268	255	
Species richness (*n*)			15	20	19	18	20	21	23	25	23	24	
Species diversity ($1/\Sigma P_i^2$)			9.9	12.9	13.9	11.5	12.4	11.9	14.7	15.4	14.0	12.8	

[1]After Diem and Zeveloff (1980). FNI=foliage nectivore-insectivore, TDI=timber drilling insectivore, GGI=ground gleaning insectivore, ASI=aerial-sally feeding insectivore, FGI=foliage gleaning insectivore, TGO=timber gleaning omnivore, FFO=foliage feeding omnivore, GGG=ground gleaning granivore, FGG=foliage gleaning granivore.

[2]After Diem and Zeveloff (1980). BTN=bush and small tree nester, PCN=primary cavity nester, CTN=conifer tree nester, SCN=secondary cavity nester, GRN=ground nester, CDN=conifer-deciduous tree nester.

[3]Logging began in September and was completed in October 1976.

[4]Probability associated with the statistical test. A small probability suggests that the change in pattern from the prelogging period to the postlogging period was different on the logged plot than on the unlogged plot. A large probability suggests no evidence for such a difference.

[5]+ indicates that the bird species was observed on a plot, but too infrequently to delineate a territory.

[6]Specific identification of the *Empidonax* flycatcher was not confirmed.

[7]Species weights from Dunning (1984).

Table 2—Mean number of individual animals trapped per year on logged and unlogged study plots, west-central Idaho, 1975 to 1979

Species	Unlogged: Prelogging	Unlogged: Postlogging	Logged: Prelogging	Logged: Postlogging	Probability[1]
Deer mouse	26.0	25.0	43.0	24.0	0.024
Yellow pine chipmunk	31.5	18.7	21.0	36.0	.001
Boreal redback vole	12.0	14.7	19.0	31.7	.329
Shrew	4.0	2.7	5.5	0	.005
Western jumping mouse	0	0	1.5	2.3	—[2]
Others[3]	0.5	1.3	5.0	2.7	.159

[1]Probability that the observed difference in pattern between the logged and unlogged plots could occur by chance alone.

[2]Probability not computed due to failure to trap any animals on the unlogged plot.

[3]Other species include the northern flying squirrel, longtail weasel, northern pocket gopher, and water vole.

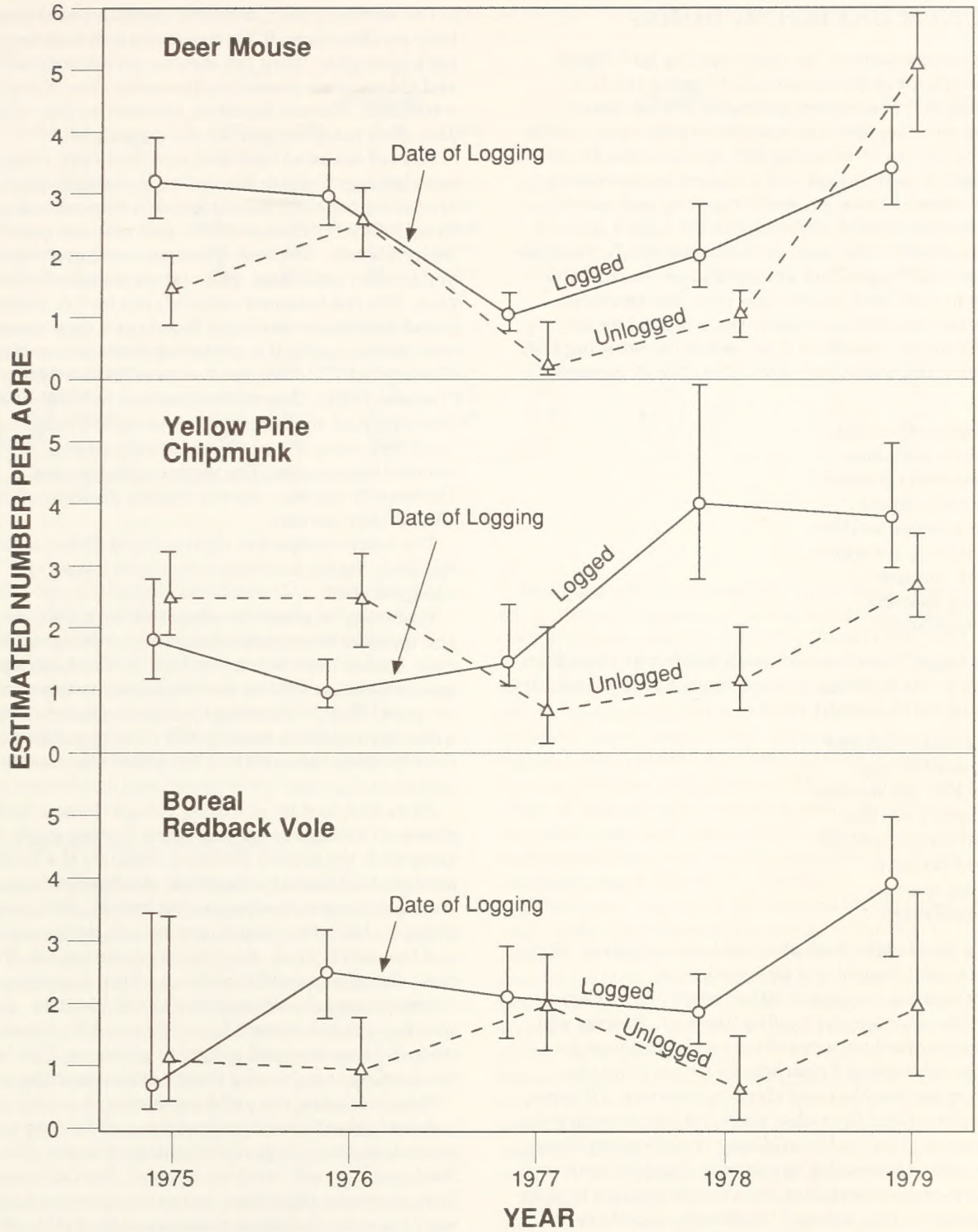

Figure 1—Estimated densities of deer mice, yellow pine chipmunks, and boreal redback voles on logged and unlogged study plots, 1975 to 1979. Confidence limits are at the 95 percent level.

RESULTS: BREEDING BIRDS

Little change occurred in total breeding bird populations as a result of the selection-cut logging (table 1). Prelogging and postlogging estimates of total density, standing crop biomass, and species diversity were similar. All but one of the 28 breeding bird species listed in table 1 were found in both logged and unlogged environments. The olive-sided flycatcher, warbling vireo, and varied thrush were territorial birds only on the logged plot. Numbers of individual species fluctuated widely from year to year on both logged and unlogged plots. Annual fluctuations in total bird populations were less extreme.

The most abundant species in the unlogged forest—each making up more than 5 percent of the breeding bird community and collectively accounting for 77 percent—were:

Empidonax flycatcher
mountain chickadee
red-breasted nuthatch
Swainson's thrush
yellow-rumped warbler
MacGillivray's warbler
western tanager
chipping sparrow
dark-eyed junco

In the logged forest, species each making up more than 5 percent of the breeding bird community and collectively accounting for 65 percent were:

Empidonax flycatcher
Swainson's thrush
yellow-rumped warbler
Townsend's warbler
MacGillivray's warbler
western tanager
chipping sparrow
dark-eyed junco

Among these eight most abundant species, seven were common to both logged and unlogged plots.

Several species responded either positively or negatively to the selection-cut logging (table 1). Species with significant upward patterns of numerical response included the olive-sided flycatcher, Swainson's thrush, yellow-rumped warbler, and chipping sparrow. Of these, only the olive-sided flycatcher nested in the overstory; the others nested either in the midstory or understory layers of vegetation. Olive-sided flycatchers, chipping sparrows, and yellow-rumped warblers have shown positive numerical responses to tree removal treatments elsewhere in western coniferous forests (Medin 1985).

Each of the four species showing a positive response to the logging treatment is classified as having a medium versatility rating with respect to reproduction and feeding orientation, and each is characteristic of shrub-forest ecotonal habitats (Thomas 1979). All but the yellow-rumped warbler are oriented to a variety of successional habitats (Thomas 1979). Each is a common summer resident throughout the coniferous forests of central Idaho (Burleigh 1972).

The warbling vireo, a bird of deciduous shrub and tree habitats (Burleigh 1972), was found as a breeder only on the logged plot. More tall shrubs, particularly willows and alders, were present on the moist sites of the logged watershed. Hermit thrushes, common on the unlogged plot, were not often seen on the logged plot.

The red-breasted nuthatch and the brown creeper responded negatively to the timber harvest (table 1). Both are bark gleaners typically found in late-successional forest habitats (Thomas 1979), and both are secondary cavity nesters. The brown creeper nests under loose bark and is often associated with mature stands of ponderosa pine. The red-breasted nuthatch is a bird of coniferous or mixed coniferous-deciduous forests and may excavate its own nesting cavity if a natural cavity is not available (Burleigh 1972). Both species have low versatility ratings (Thomas 1979). Others (summarized in Medin 1985) have reported similar negative numerical responses by the brown creeper and red-breasted nuthatch to tree removal treatments. The western tanager and Townsend's solitaire showed weaker patterns of decline after timber harvest.

The hairy woodpecker and northern flicker maintained relatively stable densities on both the logged and unlogged plots.

Birds may be placed in categories, or guilds, to organize and compare functional relationships within the community. Guilds were defined by Root (1967) as groups of species that use similar environmental resources in similar ways. The 28 breeding bird species listed in table 1 were organized into feeding and nesting guilds based on their foraging behavior and the substrates used for nesting (table 3).

Birds that feed by searching foliage (foliage feeders and gleaners) formed the largest single feeding guild. These, along with the ground gleaners, made up the largest proportion of all feeding categories. Among the foliage feeders, insectivorous species predominated. The ground gleaners, including chipping sparrows, dark-eyed juncos, and Cassin's finches, were largely granivorous. Two species—the olive-sided flycatcher and the *Empidonax* flycatcher—were classified as aerial-sally feeders. And two species—the red-breasted nuthatch and the brown creeper—were grouped as timber gleaners. The hairy woodpecker was the only timber driller represented.

Foliage feeders, the guild containing the most species, had the highest total density among all feeding or nesting guilds in both the logged and unlogged forest. The Swainson's thrush, western tanager, MacGillivray's warbler, mountain chickadee, and yellow-rumped warbler were the most abundant members of the guild. Of these, only the western tanager declined after logging. Among all feeding guilds, only the timber gleaners were adversely affected by the logging treatment. The negative response of this guild reflects the significant reductions in density of the brown creeper and red-breasted nuthatch, both timber gleaners. Foliage feeders, aerial-sally feeders, and timber drillers were about equally abundant before and after logging. Ground gleaners were slightly more abundant in the logged forest.

Table 3—Guild density (pairs per 100 acres) of breeding birds on logged and unlogged study plots, west-central Idaho, 1975 to 1979

Guild	Density									
	Unlogged					Prelogging		Postlogging[1]		
	1975	1976	1977	1978	1979	1975	1976	1977	1978	1979
Feeding										
Foliage feeders-gleaners	111.1	121.0	109.8	121.2	103.5	137.3	157.2	163.3	164.8	168.5
Aerial-sally feeders	13.7	20.0	20.0	17.5	16.2	31.2	25.0	23.7	31.2	31.2
Timber drillers	2.5	2.5	5.0	2.5	5.0	1.2	5.0	2.5	2.5	2.5
Timber gleaners	21.2	17.5	21.2	27.5	37.4	28.7	23.7	17.5	16.2	22.5
Ground gleaners	46.2	53.7	56.2	33.7	41.2	42.4	47.5	59.9	67.3	55.0
Nesting										
Conifer tree nesters	36.2	49.9	37.5	27.5	23.7	46.2	57.4	53.6	58.6	51.2
Conifer-deciduous tree nesters	42.5	33.7	36.2	43.7	36.1	51.2	49.9	58.6	63.7	60.0
Bush and small tree nesters	54.9	68.7	66.1	62.5	67.4	69.8	71.2	73.6	83.6	103.6
Primary cavity nesters	6.2	5.0	7.5	5.0	7.5	2.4	7.5	5.0	3.7	5.0
Secondary cavity nesters	34.9	35.0	39.9	42.5	47.4	41.2	38.7	32.5	28.7	31.2
Ground nesters	20.0	22.4	25.0	21.2	21.2	30.0	33.7	43.6	43.7	28.7

[1]Logging began in September and was completed in October 1976.

Among the six nesting guilds represented, only the secondary cavity nesters reacted negatively to logging (table 3). Numerically, cavity-nesting species made up 22 percent of the breeding bird community on the unlogged plots compared to 15 percent on the logged plot. Primary cavity nesters had similar densities on both logged and unlogged plots. There was a tendency toward increases in bush and small tree nesters, especially evident in the second and third years after logging.

RESULTS: SMALL MAMMALS

Nine species of small mammals were trapped during the 5-year study (table 2). Deer mice, yellow pine chipmunks, and boreal redback voles accounted for 93 percent of the 815 individual animals trapped. Each of those species was trapped each year on both logged and unlogged plots. No shrews were caught in the logged forest. Western jumping mice were trapped only in the logged watershed. Other species, including the northern flying squirrel, longtail weasel, northern pocket gopher, and water vole, were trapped irregularly and in smaller numbers. There were large differences in the number of small mammals trapped each year in both the logged and unlogged forest.

Deer mouse populations fluctuated irregularly during the study (fig. 1). Estimated densities in the unlogged forest ranged from 0.2 to 5.0 animals per acre. Annual fluctuations were less pronounced in the logged watershed. Deer mouse populations were similar on both logged and unlogged plots during the postlogging period. A different pattern of response is suggested when trapping results are expressed as the mean number of individual animals trapped per year in prelogging and postlogging environments (table 2). Significantly fewer individual deer mice were trapped on the logged plot during the postlogging period.

Studies conducted elsewhere in the West found different patterns of response. Gashwiler (1970), Halvorson (1982), Hooven and Black (1976), Tevis (1956), and Van Horne (1981) found more deer mice on logged areas when compared with nearby unlogged habitats. Yet others reported either similar or higher deer mouse populations in uncut forests when compared with recently logged areas (Harris 1968; Petticrew and Sadleir 1974; Scott and others 1982; Sullivan 1979). Differences in the effect of logging may be partly a result of differences in the amount of cover remaining on logged areas as well as variations in food availability characteristic of early successional stages (Van Horne 1981).

Yellow pine chipmunk populations on the logged area were larger than those of the uncut forest (fig. 1). Logging resulted in a nearly twofold increase in estimated density, reaching a high of 4.1 animals per acre in the second year following logging. The number of individual chipmunks trapped showed a significant pattern of positive response to the timber harvest (table 2). It was the most commonly trapped small mammal in the logged forest. The yellow pine chipmunk is an adaptable species, occupying a variety of forested habitats and a wide range of successional stages (Thomas 1979). It is particularly abundant in open stands of ponderosa pine and Douglas-fir (Rickard 1960).

Annual fluctuations in redback vole populations were less extreme than those of the deer mouse and yellow pine chipmunk (fig. 1). Estimated densities in the unlogged forest ranged from 0.7 to 2.0 animals per acre. Populations on the logged plot were only slightly higher than those on the unlogged plot. No significant difference was found in the number of individual redback voles trapped in the cut and uncut forest (table 2). Conversely, redback voles were not found on a nearby plot when the slash was burned following diameter-cut logging (Medin 1986). Scott and others (1982) reported little difference in the

number of redback voles trapped on logged and unlogged areas in Colorado when the slash was left on the ground. Logged habitats seem to support redback voles only when logs or other debris are present (Tevis 1956; Simons 1985). Redback voles apparently prefer moist habitats with an abundant litter of stumps and rotting logs (Merritt 1981).

Other species of small mammals were either trapped or observed in the Douglas-fir forest. Only a few shrews were caught during the study, and those only in the unlogged forest (table 2). The forest environment was apparently sufficiently altered by the selection cut that it became a less suitable habitat for shrews, at least in the short term. Western jumping mice were trapped only in the moist streamside zones found on the generally north-facing watershed. The species prefers the wet meadows, bogs, and brushy streamsides associated with riparian habitats (Thomas 1979). Incidental numbers of the northern flying squirrel, longtail weasel, water vole, and northern pocket gopher were trapped. Red squirrels were common on both the logged and unlogged plots. The marten was rarely observed and only in the unlogged forest. The trapping methods used are not an effective means of determining the numbers of most of these species.

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APPENDIX I: COMMON AND SCIENTIFIC NAMES OF BIRDS AND SMALL MAMMALS OBSERVED ON THE STUDY AREA

Birds

Turkey vulture	*Cathartes aura*
Sharp-shinned hawk	*Accipiter striatus*
Cooper's hawk	*Accipiter cooperii*
Northern goshawk	*Accipiter gentilis*
Red-tailed hawk	*Buteo jamaicensis*
Golden eagle	*Aquila chrysaetos*
American kestrel	*Falco sparverius*
Spruce grouse	*Dendragapus canadensis*
Blue grouse	*Dendragapus obscurus*
Ruffed grouse	*Bonasa umbellus*
Great horned owl	*Bubo virginianus*
Northern pygmy-owl	*Glaucidium gnoma*
Calliope hummingbird	*Stellula calliope*
Yellow-bellied sapsucker	*Sphyrapicus varius*
Williamson's sapsucker	*Sphyrapicus thyroideus*
Downy woodpecker	*Picoides pubescens*
Hairy woodpecker	*Picoides villosus*
White-headed woodpecker	*Picoides albolarvatus*
Three-toed woodpecker	*Picoides tridactylus*
Black-backed woodpecker	*Picoides arcticus*
Northern flicker	*Colaptes auratus*
Pileated woodpecker	*Dryocopus pileatus*
Olive-sided flycatcher	*Contopus borealis*
Empidonax flycatcher	*Empidonax* spp.
Gray jay	*Perisoreus canadensis*
Steller's jay	*Cyanocitta stelleri*
Clark's nutcracker	*Nucifraga columbiana*
Common raven	*Corvus corax*
Mountain chickadee	*Parus gambeli*
Red-breasted nuthatch	*Sitta canadensis*
White-breasted nuthatch	*Sitta carolinensis*
Brown creeper	*Certhia americana*
Winter wren	*Troglodytes troglodytes*
Golden-crowned kinglet	*Regulus satrapa*
Ruby-crowned kinglet	*Regulus calendula*
Townsend's solitaire	*Myadestes townsendi*
Swainson's thrush	*Catharus ustulatus*
Hermit thrush	*Catharus guttatus*
American robin	*Turdus migratorius*
Varied thrush	*Ixoreus naevius*
Solitary vireo	*Vireo solitarius*
Warbling vireo	*Vireo gilvus*
Nashville warbler	*Vermivora ruficapilla*
Yellow-rumped warbler	*Dendroica coronata*
Townsend's warbler	*Dendroica townsendi*
MacGillivray's warbler	*Oporornis tolmiei*
Western tanager	*Piranga ludoviciana*
Black-headed grosbeak	*Pheucticus melanocephalus*
Chipping sparrow	*Spizella passerina*
Song sparrow	*Melospiza melodia*
Dark-eyed junco	*Junco hyemalis*
Brown-headed cowbird	*Molothrus ater*
Pine grosbeak	*Pinicola enucleator*
Cassin's finch	*Carpodacus cassinii*
Red crossbill	*Loxia curvirostra*
Pine siskin	*Carduelis pinus*
Evening grosbeak	*Coccothraustes vespertinus*

Small Mammals

Shrew	*Sorex* spp.
Yellow pine chipmunk	*Tamias amoenus*
Red squirrel	*Tamiasciurus hudsonicus*
Northern flying squirrel	*Glaucomys sabrinus*
Northern pocket gopher	*Thomomys talpoides*
Deer mouse	*Peromyscus maniculatus*
Boreal redback vole	*Clethrionomys gapperi*
Water vole	*Arvicola richardsoni*
Western jumping mouse	*Zapus princeps*
Marten	*Martes americana*
Longtail weasel	*Mustela frenata*

Medin, Dean E.; Booth, Gordon D. 1989. Responses of birds and small mammals to single-tree selection logging in Idaho. Res. Pap. INT-408. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 11 p.

Short-term changes in small mammal and breeding bird populations following selective logging in an Idaho Douglas-fir forest are quantitatively described. The study, conducted from 1975 to 1979, compared the composition and abundance of birds and small mammals on a logged plot with those on an unlogged plot.

KEYWORDS: *Pseudotsuga menziesii*, helicopter logging, nongame birds, rodents, timber harvesting, wildlife habitat

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